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Title: Report on measurements of a 1.568 Mbps single pair HDSL system

Source: Metalink Transmission Devices

Contact: Avi Kliger
Metalink
8 Elkahi St.
Tel Aviv,
ISRAEL

Tel: + (972) 3 6420006
Fax: + (972) 3 6420070
Email: avi@metalink.co.il

ABSTRACT

This contribution presents performance results of an existing single pair HDSL system operating at a data rate of 1.568 Mbps.The tests were carried out on five different CSA loops (loops #1,4,6,7,8). The results show that, on four of the loops, 86-93% of the CSA length, is reached by a single pair HDSL system, while maintaining the required 6 dB margin over near end cross talk generated by 49 single pair disturbers.In particular, with 6 dB NEXT margin, the reach over a 24 AWG wire is 10600 feet and over a 26 AWG wire is 7800 feet.

1. Introduction

Recently, following the need for lower-cost copper-saving 1-Pair HDSL technology, and the availability of such technologies, a single pair HDSL system has been suggested. Two main issues must be investigated in order to evaluate such systems. Performance in terms of copper reach and compatibility with other metallic access technologies.

This report summarizes performance test results of an existing single pair HDSL system, operating at data rates of 1.568 Mbps. The spectrum compatibility issue is considered in [1,2].

The performance was measured in the presence of Near End Cross Talk (NEXT) generated by 49 disturbers. The margin performance achieved with several loop lengths, as well as the maximum reach where 6 dB margin is available were measured.

2. Transmitted signal

The transmitted signal is a conventional baseband 2B1Q modulated signal. The measured power spectral density is depicted in Figure 2. The transmitted power is 13.5 dbm measured on a 135 ohm termination

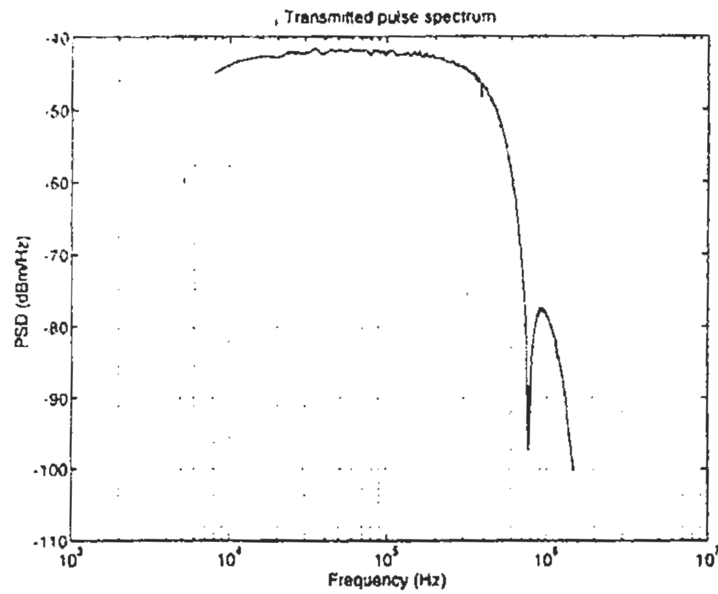

FIGURE 1. Power Spectral density of the transmitted signal

3. Test Set-Up

The tests were carried out using the Consultronics DLS-400 line simulator, as well as a real 0.4 mm and 0.5 mm real cables. The test setup is shown in Figure 2. Simulated near end cross-talk was generated by an arbitrary signal generator (OR-X) and was applied to the Remote unit (HTU-R), using the circuitry shown in Figure 3.

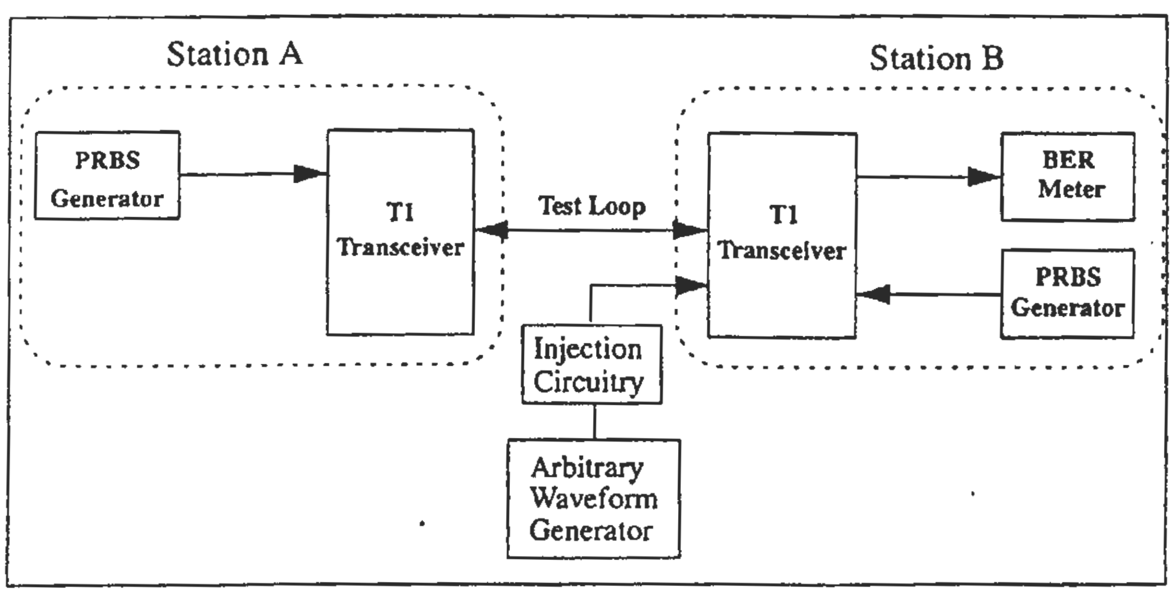

FIGURE 2. Test Configuration

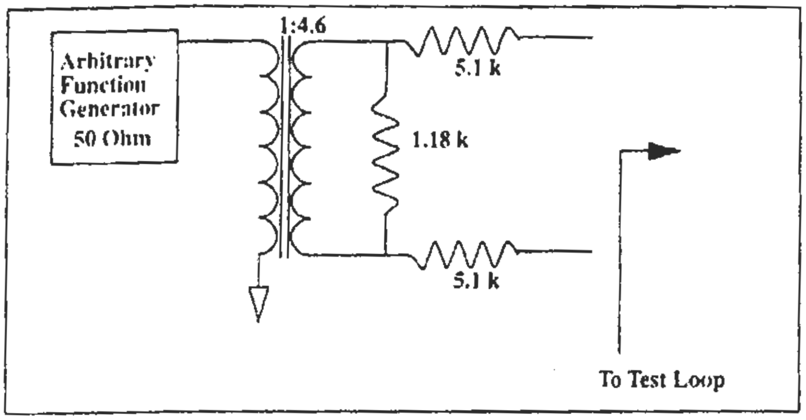

FIGURE 3. NEXT Injection circuitry

3.1. Test Loops

The performance of the single pair HDSL was tested on loops, as close as possible to CSA loops #1,4,6,7,8, but with one section made to be of variable length. In each loop the variable length section was chosen to be the longest section.

The implemented loops are shown in Figure 4. Whenever possible, the loops sections were implemented using the DLS-400. Sections that were not available in the DLS-400 were implemented using real cable. Those sections are marked by (*).

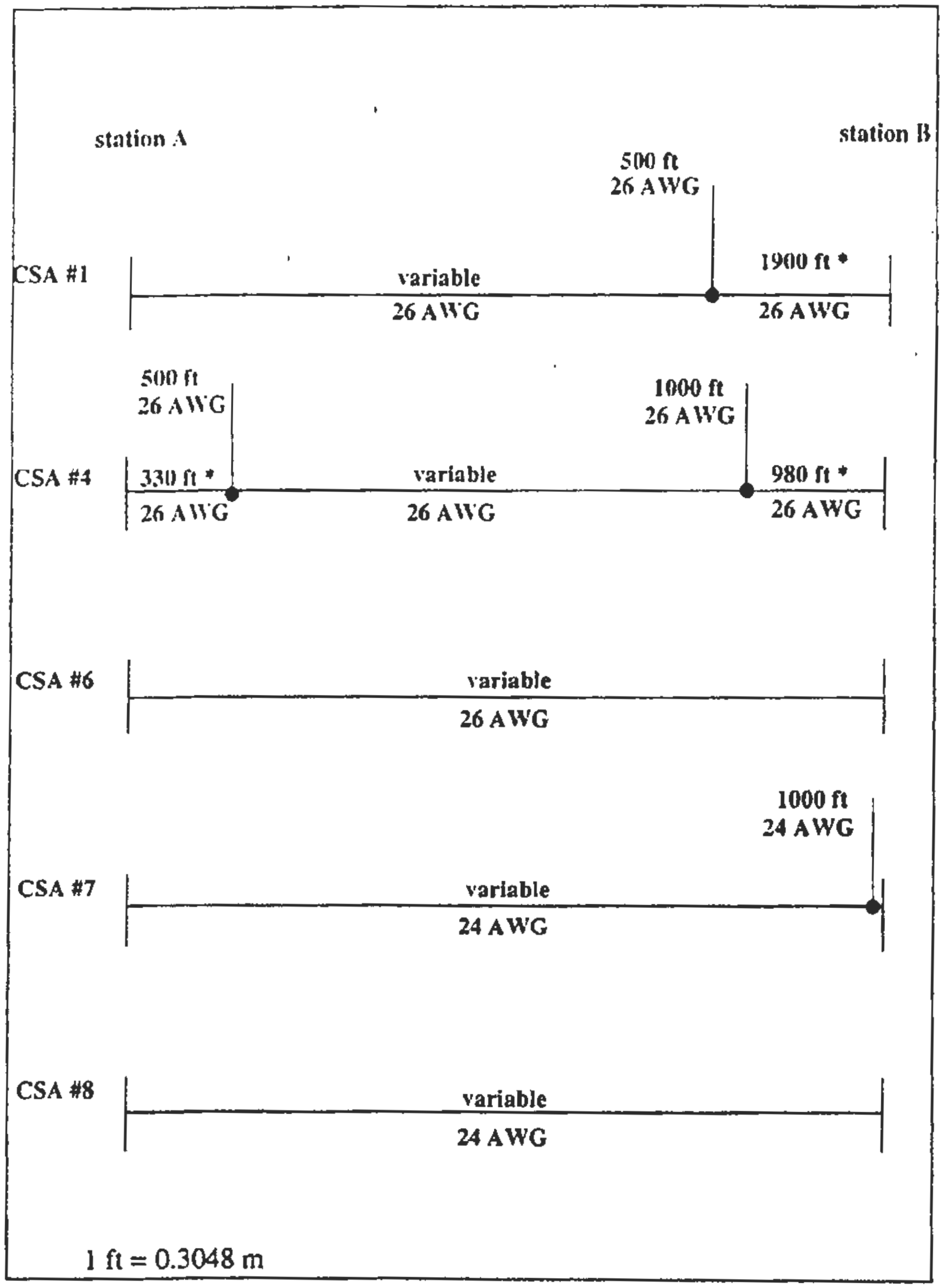

FIGURE 4. Simulated Test Loops

3.2. Simulated Crosstalk

The simulated Near End Crosstalk (NEXT) was generated and calibrated according to the ANSI recommendation, using the following equation:

$$P_{NEXT} = K \times \left[\operatorname{sinc}\left(\frac{\pi \times f}{f_0}\right)\right]^2 \times \frac{f^{\frac{3}{2}}}{1.134 \times 10^{13}}$$

where:

$$K = \frac{5}{9} \times \frac{V_p^2}{135}$$

f = frequency in Hz
f_0= 784000 Hz
V_p= 2.4 Volts.

. This noise simulates 1% worst case self near end cross talk from forty nine single pair HDSL disturbers. The injected NEXT Power Spectral Density (PSD) was measured on a 67 ohm termination and is depicted in Figure 5. The output sampling rate of the arbitrary signal generator was equal to eight times the baud rate.

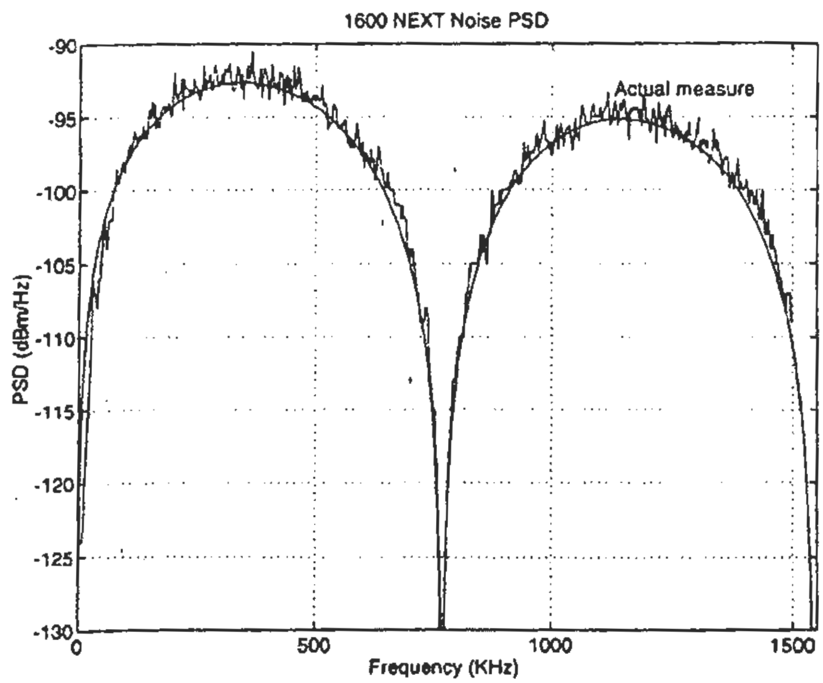

FIGURE 5. 1-Pair NEXT PSD (Measured.vs. specified)

4. Test Results

4.1. Reach on various CSA loops

In order to evaluate the reach of the single pair HDSL system, the variable length section on each loop was adjusted to have the required 6 dB margin. The adjusted length, the total loop length (not including bridge taps) and the total CSA loop lengths (not including bridge taps) are depicted in Table 1.

The tests were carried out on forward (from station A to station B) and reversed (from station B to station A) directions of the asymmetrical loops.

Table 1: Reach of a Single Pair HDSL system

LOOP	variable length (feet)	total loop length (feet)	total CSA loop length (feet)	% reach of the CSA loop
#1	5000	6900	7700	89
#1 - rev.	5000	6900	7700	89
#4	4550	5860	7600	77
#4 - rev.	4500	5810	7600	76
#6	7800	7800	9000	86
#7	10000	10000	10700	93
#7 - rev.	9200	9150	10700	86
#8	10600	10600	12000	88

4.2. Margin performance on 24 AWG and 26 AWG wires

the margin performance as a function of loop length for the simulated 24 AWG, and 26 AWG wires is depicted in Figure 6, and Figure 7, respectively.

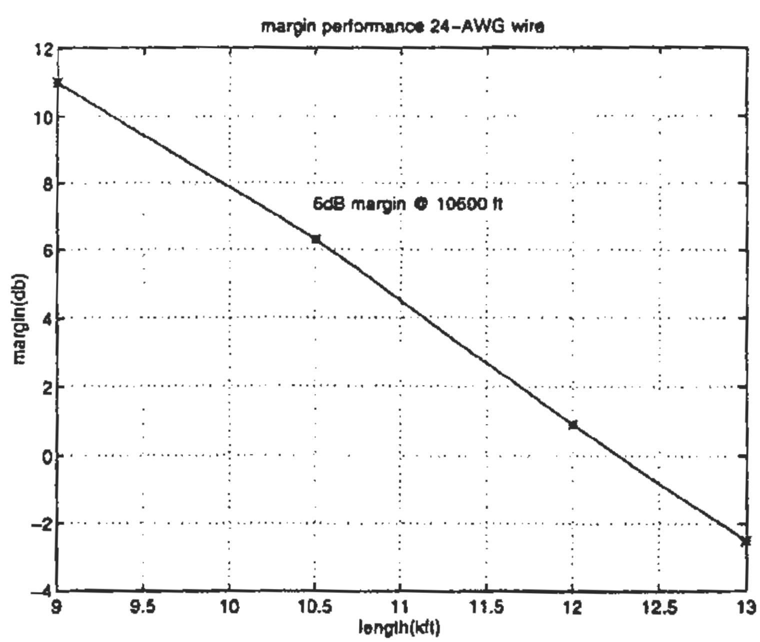

FIGURE 6. Margin performance over 24 AWG wire

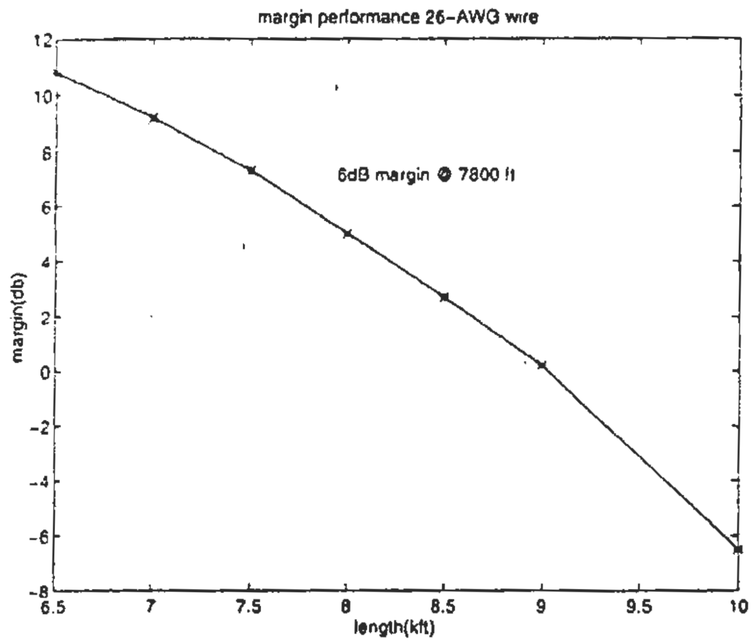

FIGURE 7. Margin performance over 26 AWG wire

5. Reference

[1] A. Kliger, " 1-Pair HDSL spectrum compatibility with 2-Pair HDSLand ISDN-BA analysis", T1E1.4/95/071

[2] A. Kliger, "1-Pair HDSL spectrum compatibility with DMT-ADSL analysis", T1E1.4/95/070